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ABSTRACT

The capacity to appreciate and produce metaphoric language is thought to develop at adolescence. Yet metaphors are frequently noted in the speech of preschool children. To resolve this apparent contradiction, a test probing metaphoric capacity was devised. Matched groups of subjects ranging in age from 3 1/2 to 19 were required to indicate knowledge of the literal meanings of antonymous word pairs and then to project these terms into domains where they only apply in a metaphoric way. Though there was improvement with age, preschool children demonstrated considerable ability at this task; the order of difficulty of words and domains were regular across age, except for an isolated difficulty displayed by the preschool children in projecting words onto swatches of color; reasons for matches differ markedly across ages. Whether metaphoric capacity is attributed to children appears to depend on whether the ability to select acceptable metaphors or an explicit awareness of the rationale for the metaphor is the criterion. The distinction between an operative skill and an awareness of its existence, and the preconditions for metaphoric competence are discussed. (Author)

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METAPHORS AND MODALITIES:

HOW CHILDREN PROJECT POLAR ADJECTIVES ONTO DIVERSE DOMAINS

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The spontaneous speech of preschool children contains numerous similes, metaphors, and other figures of speech (Chukovsky, 1963; Gardner, 1973a, Chapter 4). Yet the scant experimental literature on the topic suggests that metaphoric speech emerges only at a later age (Asch and Nerlove, 1960; Elkind, 1969; Gardner, 1973a, Chapter 4; Schaffer, 1930). It is argued by Asch and Nerlove, for example, that pre-adolescent children cannot appreciate the dual meanings of terms; they are sensitive to the literal application of a descriptive term, while resisting metaphoric projection. More generally, the capacity for poetic or metalinguistic usage, for ope ating upon linguistic elements themselves, is generally considered the last facet of language to develop (Inhelder and Piaget, 1958; Jakobson, 1960, 1970). There is thus significant disagreement between observational studies and claims in the experimental literature. The present study is an attempt to determine whether the ability to make metaphoric links can be found in the preschool child, to examine aspects of the development of metaphoric capacity, and if possible to reconcile the inconsistencies among previous claims.

As usually defined, a metaphor is a figure of speech in which a descriptive term is applied to a referent for which it is not literally appropriate, but to which it bears certain analogies. Though, on this definition, a metaphor operates exclusively within the linguistic sphere, the ability to utilize metaphors presupposes the capacity to perceive relations among disparate phenomena. For a loud noise to be compared to a bright color, the common "expansive" property of

both entities must be recognized. Then a verbal formula must be devised such that explicit reference is made to one sensory domain (the crimson blare of trumpets) while the implicit reference to another (a swatch of color) can be apprehended.

Metaphors can draw attention to the relation between a great range of terms or referents. A loud noise can be compared not only to a color, but also to a felt material, an abstract line configuration, a facial expression, or a verbal description. Which particular line, face, description, etc., is metaphorically linked to loudness is a communal decision dependent, in part, on the alternatives available and the nature of the surrounding context (Gombrich, 1960; Goodman, 1968). A task requiring perception of a common property between diverse elements and the ability to capture this relation in a verbal formula thus models central aspects of the production of a metaphor, while falling within the information-processing capacities of preschool children.

Interest in the development of a metaphoric capacity led to the devising of a simple test of metaphoric capacity. Metaphoric capacity was operationalized as the ability to project in an appropriate manner sets of antonymous or "polar" adjectives whose literal denotation within a domain (sensory modality or other coherent system) is known onto a domain where they are not ordinarily employed. By drawing from a variety of domains, a large collection of potential metaphors was obtained; this procedure ensured that the subjects' capacities to appreciate "fresh" (as opposed to "established") metaphors would be ascertained. The domains included a verbal description (metaphor strictly construed) and elements drawn from various sense modalities (metaphor defined as above). By administering this test to subjects of different ages, information was obtained on 1) the age at which metaphoric capacity is initially evident; 2) the developmental trends governing this ability; 3) the difficulty posed by particular words and domains in metaphoric projection; 4) the strategies adopted and reasons given for particular selections.

Methods

Subjects: Ten college students were used as judges in a pilot study. Thereafter, the test was given to 101 subjects, with approximately equal numbers of girls and boys at four age levels: the mean ages of the four groups were 3 1/2, 7, 11 1/2, and 19 years of age. Except for the college students, middle-class volunteer subjects included primarily to verify the performance of the pilot judges and provide a baseline of performance, the students were drawn primarily from working class and lower middle class backgrounds as determined by parental occupations. Subjects were selected at random from their day care or school classes and were tested individually in a quiet room.

Materials and Procedure: Five pairs of polar adjectives familiar to preschool children were selected as the terms to be mapped onto diverse domains. The pairs were light/dark, happy/sad, loud/quiet, hard/soft, and warm/cold. These pairs were considered representatives of the following domains: visual (color), visual-physiognomic (facial expressions), auditory (pitches), tactile (objects felt while blind-folded), verbal-kinesthetic (a general bodily feeling expressed in words).

Materials from each of these domains (colors, photographs of facial expressions, recorded sounds, simple objects for tactile presentation, and short descriptive phrases) were then collected. In addition, pairs of abstract line configurations were constructed. The latter materials were included because they have been used in previous studies of figurative language (Werner and Kaplan, 1963) and because this class of materials is typically described in a metaphoric way.[1] Each pair of polar adjectives (e.g. loud/quiet) was then paired with one literal realization in the appropriate domain (e.g. two recorded samples of the same pitch differing only in loudness) and with various metaphoric realizations drawn from the other domains (e.g. "loud" and "quiet" color samples, tactilely-perceived objects, faces, phrases, and line configurations).

Literal and various metaphoric exemplifications of the five pairs of polar adjectives were shown to the ten pilot subjects. In each case the subject was first required to indicate knowledge of the meaning of a pair of adjectives (e.g. loud and quiet) by mapping it onto elements from the domain in which it is customarily used (two pitches). Then the subject was presented with pairs of elements drawn from the five domains not customarily associated with the adjectives. (In the case of loud/quiet, these were respectively, yellow and green colors, upset and pensive faces, a jack and a ping-pong ball presented in the tactile domain, a dense and a sparse abstract configuration, and the phrases "playing on a jungle-gym" and "painting at an easel.") Only pairs of elements on which at least eight out of the ten pilot subjects concurred in their metaphoric matches were included in the final set (this level of agreement was exceeded on 23 of the 25 items). Matches made by these subjects were considered the "correct" metaphoric projections, against which the performance of the test subjects was assessed.

As a result of the pilot work, then, a test containing 25 items was established. Each pair of polar adjectives was to be matched by subjects with a pair of elements drawn from the five domains (abstract line configurations and four other domains) with which the adjectives were not ordinarily associated.

Each test subject was brought into the testing room and informally introduced to the task. The subject was told "In this game (task) you are going to see two colors (or hear two sounds, etc.). One will be light (loud, etc.), the other will be dark (quiet, etc.). Look at (listen to) both of them very carefully and tell me which is light (loud) and which is dark (quiet)." Subjects indicated by their answer to this initial question whether they comprehended the literal denotation of the adjectival pair. Only in two instances did subjects experience difficulty on these "literal" items and in each case a further illustration resolved the difficulty.

Once the literal denotation had been established, the subject was presented with the pairs of elements drawn from the five remaining domains. In each case the subject was required to match the adjectives to the elements and to give reasons for the matches. Instructions were as above, but subjects were told initially: "Now the game (task) is going to be changed. This time we're going to play two sounds (look at two colors etc.) and, again, we want you to say which is light (loud) and which is dark (quiet)." If at any time, the subject disclosed any misgivings about the task, he was assured that this was just a "special way" to play the game. No subject had appreciable difficulty in accepting these conditions.

Before being required to make the adjective-domain match, subjects were allowed to view the visually-presented elements for fifteen seconds, or to feel the tactile elements while blind-folded for thirty seconds (an average of fifteen per element). They also heard each pair of auditory patterns twice. Subjects' pairings of words and auditory patterns were required on both hearings. Since subjects gave virtually identical responses for the two hearings, only the first response is reported in the statistical analysis. After all domains for a given adjective pair had been presented, the next set of adjectives was introduced and the pattern repeated.

Half the subjects in each age and sex group received all the items in one order, the other half in the reverse order. Some pre-school children with short attention span received the test in two sessions on successive days. All other subjects received the entire task in one session.

Results

Overall Performance: Each subject's total number of "correct" answers on the 25 metaphoric matches was computed. A 2 x 4 analysis of variance indicated that there was no significant effect of sex and no interaction but that there

was a significant difference across ages ($F=44.65$, $p < .01$). With the exception of three preschool subjects who scored at or below the chance level, subjects received relatively high scores. The average number of errors was 2.35 for the college students, 2.75 for the 11 1/2 year olds, 5.97 for the seven year olds, and and 8.91 for the preschool children. A Scheffé post-hoc comparison of means indicated that there were significant differences in the number of correct answers among all the age groups except for the oldest two, whose scores were virtually identical.

Order of Difficulty of Items, Adjective Pairs, and Domains: The 25 test items were ranked for each age group according to the number of errors made on each. A Kendall coefficient of concordance of .66 ($p < .01$) obtained in item difficulty across age groups. Computation of the difficulty of the five pairs of adjectives across age groups yielded a coefficient of concordance of .68, also highly significant ($p < .01$). On the average, warm/cold were the hardest words to map onto domains, hard/soft the easiest, loud/quiet the next easiest, and the remaining pairs of moderate difficulty.

The order of difficulty of the six domains was ranked within each age group and a coefficient of concordance of .50 across age groups ($p \simeq .05$) was computed. Averaged across ages the verbal kinesthetic domain was the easiest to match metaphorically with adjectives, visual-color and visual-physiognomic were the next easiest, abstract lines and tactile were of intermediate difficulty, and auditory was the most difficult domain to match. An unexpected finding was that color was the easiest domain for the four older groups to match, while it was the most difficult for the preschoolers. If preschoolers were not included in the computation, the coefficient of concordance rises to .76 ($p < .01$); and if color domain is omitted, the correlation of domains across ages rises to .79 ($p < .01$). Reasons for the particular difficulty of younger

subjects with color matches has been the subject of a recent pilot study. The results indicate that a group of preschoolers matched to the initial subjects generally could name colors and could select the appropriate colors for common objects. It appears that the color difficulties of this age are specific to a metaphoric task.

Repeated-measures analyses of variance indicated that the difference in difficulty of specific domains and polar adjectives was not significant. T-tests do yield significant differences between the easiest and hardest domains within certain age groups but little weight is attached to these marginal findings.

Item Analysis: Performances on each of the 25 test items were reviewed in an effort to discern significant patterns. Of the six items on which there were a total of less than ten errors across ages, three involved the adjectives hard and soft (to color, faces, and verbal-kinesthetic domains). Even the youngest subjects found it easy to evaluate perceptual experiences along this dimension. Only two errors were made in matching loud/quiet to two faces; since one face had an open mouth, this item may approach being a literal description of a shouting individual.

There were six items on which there were over 30 errors. These items included matching cold/warm to faces, abstract line configurations, and sounds, light/dark to verbal-kinesthetic descriptions, and loud/quiet to verbal-kinesthetic descriptions. Kinesthetic phrases, which refer to subjective feelings rather than communically verified sensory elements, proved especially difficult for younger subjects to match. Similarly, abstract configurations seem to pose more problems than more familiar inputs to various sensory domains.

Separate analysis was made of the 16 items on which over 2/3 of the errors were made by the younger two groups of subjects. Analysis of responses and subjects' comments indicated that the principal factors leading to superior

performance in the older groups were mastery of the precise meaning of a word, elimination of idiosyncratic associations, and acquaintance with certain conventions ("blue" is "cold", "yellow" is "loud").

There were two items on which seven year olds made a significantly greater number of errors than preschoolers. The seven year old erroneously equated "having lots of presents on your birthday" with dark and "having no presents..." with the light, because, as several subjects explained, "lots of presents are heavy to carry." Here the contrast light/dark was apparently assimilated to the contrast "light/heavy." The other miscue involved an erroneous equation of a tactile-perceived ping-pong ball with loud and a tactile-perceived jack with quiet; in this case, subjects reported that the ping-pong ball would make more noise if it fell. Here an action in which the elements might be involved overwhelmed the more conventional association of pointed compactness with noise and smooth emptiness with silence.

Strategies: Analysis of reasons given by subjects for their matches as well as other behavioral indices revealed the following characteristic patterns. Preschool children gave no answers on over half the items; on those where they responded, their replies were brief, often irrelevant, at best approximate. These was a striking tendency for subjects to touch the materials, particularly when a tactile word was employed. Other prevalent practices were assimilation (all matches described as examples of one property, such as "it's noisy"), literal descriptions (the lines are "loud" because they are "all together"), and translation of one set of terms into another ("hard" and "soft" consistently equated with "nice" and "bad"). In general, these subjects' capacity to make appropriate matches far exceeded their ability to provide suitable rationalizations.

The seven year olds gave reasons on over 75% of the items. These responses were more appropriate than the preschoolers' but extremely concrete and subjective.

An easel is loud "because you hear the brush", "a (square) is cold because it's like ice." Red is warm "because fire is warm." There was also an appreciable number of somewhat irrelevant thematic answers ("an angry face is cold because someone threw ice at it"..."little bits of clay are small and small people are usually happy").

The 11 1/2 year olds gave a greater variety of answers which were generally more informative and relevant than those of the younger subjects. These subjects were extremely sensitive to details of the stimuli (cf. Gardner, 1972, 1973a; Kennedy, 1974; Stevenson, 1972); only at this age group did several subjects notice a slightly darker pen mark on one of the stimuli. Though there were frequent traces of a concrete tendency, several new lines of reasoning make their appearance among pre-adolescents; affective answers (angry face is cold "because it makes you feel cold"); "scientific" rationales ("higher notes have faster sound waves"); conventional rules ("a bigger size usually means it's louder"), multiple explanations ("The ping-pong ball is loud because it is bigger, larger, and hollower"); and awareness of alternatives ("I see lines pointing upward as dark but other people usually don't"). There were also a few of the "intermediate-term" explanations which become more prevalent among the oldest subjects.

The college students gave even more answers and there was a tremendous variety of reasons even within particular subjects. Indeed some subjects produced the full range of reasons. The characteristic strategy at this age involves awareness of the multiple meanings of adjectives and emphasis of intermediate, somewhat abstract terms which mediate between the word and the domain. ("The sharpness of the jack makes it loud," "that line is loud because it is intense, or dynamic, or vehement", "the line is happy because it is smooth and airy"). Subjects frequently cited several literal and metaphoric meanings of a word,

invoked the laws of physics, spoke in terms of cultural conventions ("curved lines are soft and warm", "high notes are soft"), or general mood ("I'd be in a light mood if I got lots of presents"). Some subjects created a scene which linked the elements ("These lines are sad because they look like clouds on a late afternoon when you have nothing to do"). In general, the students were aware of other potential responses to an item . . .mes prefaced their answers "I know you could see it the other way but ..." Interestingly, a few errors occur at this age when subjects employ too elaborate a chain of reasoning ("a cloudy afternoon is happy because the storm is passing").

Discussion

The results indicate that younger children from lower socio-economic backgrounds can succeed on a metaphoric task and that pre-adolescents are already performing at an adult level. Applying a descriptive term to a domain where it is not ordinarily employed does not pose formidable difficulties for children; the ability to create appropriate figures of speech in spontaneous conversation can be modelled in an experimental paradigm.

Comparisons across ages of the order of difficulty of particular items, words, and domains indicates, furthermore, that the essential capacity for metaphoric association retains the same pattern throughout development. The only exception to this generalization is the particular difficulty in linking words to colors characteristic of the younger children; this deficit may be due to a reluctance to apply non-literal terms to colors or to a more general reluctance to describe colors verbally. The order of difficulty of the specific domains may not be particularly significant, but the more concrete words (referring to auditory, tactile, and visual-color expressions) do appear easier to map onto sensory elements than ones which refer to internal, more subjective experience (verbal-kinesthetic).

The adult-like performance of the young subjects may reflect the ease of the task. The subject is given the metaphoric elements and merely required to choose between two possible pairings. Informal observations and recently completed ıre' (Gardner, 1973b) indicate that metaphoric behavior is less likely to emerge if younger subjects are required to produce a metaphor on their own, select a metaphoric formulation in preference to a literal one, give an appropriate reason for their choice, or make a metaphoric match when presented with a larger group of materials. Yet these tentative findings only indicate that metaphoric facility improves with age; they do not call into question the finding that a fundamental competence has developed by the time children enter school.

The study points up some factors which contribute to superior performance among the older subjects. These include familiarity with cultural conventions, awareness of the variety of connotative meanings which a word may assume, ability to posit an abstract middle-level term or to invoke physical laws. Older subjects also avoid some of the pitfalls of young subjects, such as an overly concrete approach (trying to touch the "soft" face), an unwarranted extrapolation (what will happen if a ping-pong ball falls?), an irrelevant story. Yet, while these strategies and explications illuminate the way the task is approached by different age groups, they are not intrinsic to the ability to make metaphoric matches. Some subjects who gave no reasons performed at a very high level, while some of the most sophisticated rationales led to an incorrect answer. It should be acknowledged, however, that manner of reasoning (Kohlberg, 1969) may be as important to a developed metaphoric capacity as the particular product or judgment reached. Furthermore, an acceptable metaphor need not be one on which subjects can agree beforehand; sometimes the most effective metaphor is the unexpected one which nonetheless is suitable in the particular context (Goodman, 1968). When the task is construed in that way, the ability to invoke a sophisticated rationale increases in importance, while the mere capacity to make the "correct" or "modal" match is of less moment.

There remains the question of what factors enable pre-school subjects to make appropriate matches. In the absence of detailed reasons from the subjects themselves, only an elaborate program of experimentation can designate the most important contributing factors. Nonetheless, some other lines of research suggest what the significant prerequisites for metaphoric competence may be. Studies utilizing the semantic differential indicate that young as well as older subjects organize their world around the co... factors of evaluation, potency, and activity (Snider and Osgood, 1969); presumably some translating of diverse words and domains into these "central" dimensions is taking place. The capacity to make cross-modality associations is well developed by the time a child enters school (Bond and Stevens, 1969; Geschwind, 1964); though such connections generally are made on the non-verbal level, most children by the ages of 3 or 4 are able to characterize sensory-motor experiences and associations in language (Chukovsky, 1963; McNeill, 1970; Brown, 1973) and even to categorize words along such dimensions (Rossi and Wittrock, 1971). Comprehension of antonyms has developed fairly well by this age though there are still confusions of more complex terms (Clark, 1972) and of certain marked/unmarked contrasts (Donaldson and Wales, 1970). However, the test of literal denotation administered to the subjects reduces the possibility that such confusion has contaminated the present results. Finally the ability of most children this age to name at least certain numbers, letters, and other symbolic materials, as well as their knowledge of the usual color of objects (Gardner, 1973b, c) suggest that they have already assimilated many cultural conventions; presumably such knowledge is drawn on as they project words to alien domains.

From previous studies of preschool children, then, comes considerable evidence of the cognitive and linguistic prerequisites for metaphoric competence, as well as many instances of spontaneous figurative language. The inability of these subjects to provide reasons suggests that the associations are made on an immediate

or intuitive basis, rather than as a deduction from the logical properties of the task or of the language. Perhaps it is this situation which engenders the contradictory positions outlined in the introduction. The older subject, capable of considering language itself as an object (Jakobson, 1960), is able to create metaphors in a self-conscious manner and to make explicit comparisons among alternative formulations. Because of his capacities for logical comparisons and operations (Inhelder and Piaget, 1958) he can explicitly point out the dual meaning of a lexical term (Asch and Nerlove, 1960). These capacities aid the older child in making consistent metaphoric matches, invoking sophisticated rationales, injecting metaphoric elements deliberately into his speech and writing.

These capacities, however, are of a different order from the abilities to 1) utilize metaphor spontaneously in one's speech and 2) make a metaphoric match when the relevant elements are provided. Metaphors in daily speech may be a consequence of imprecise definitions of a word (Ervin and Foster, 1960; Nunmedal and Murray, 1969; Brown, 1958) and of the proclivity to make associations among disparate elements (Honkavaara, 1961; Werner, 1948); both these tendencies are quite commonly found in young children. Metaphoric matches in a controlled situation presupposes an ability to make cross-modal matches, some appreciation of antonymy, the capacity to organize experiences along common dimensions, and the ability to honor cultural conventions. Since there is independent evidence for each of these tendencies in the young child, it should not be surprising that the basic components of "metaphoric thought" have developed by the fourth year of life.

REFERENCES

Asch, S. & Nerlove, H. The development of double function terms in children: An exploratory study. In B. Kaplan & S. Wapner (Eds.) Perspectives in psychological theory. New York: International Universities Press, 1960.

Bond, B. & Stevens, S. S. Cross-modal matching of brightness to loudness by five-year olds. Perception and Psychophysics, 1969, 6, 337-339.

Brown, R. How shall a thing be called? Psychological Review, 1958, 65, 14-21.

Brown, R. A first language: the early stages. Cambridge, Mass.: Harvard University Press, 1973.

Chukovsky, K. From two to five. Berkeley, Calif.: University of California Press, 1963.

Clark, E. On the child's acquisition of antonyms in two semantic fields. Journal of Verbal Learning and Verbal Behavior, 1972, 11, 750-758.

Donaldson, M. & Wales, R. On the acquisition of some relational terms. In J. R. Hayes (Ed.) Cognition and the development of language. New York: Wiley, 1970.

Elkind, D. Piagetian and psychometric conceptions of intelligence. Harvard Educational Review, 1969, 39, 319-337.

Ervin, S. M. & Foster, G. The development of meaning in children's descriptive terms. Journal of Abnormal and Social Psychology, 1960, 2, 271-275.

Gardner, H. Style sensitivity in children. Human Development, 1972, 15, 335-338.

Gardner, H. The arts and human development. New York: Wiley, 1973 (a).

Gardner, H. Children's metaphoric productions and preferences. Unpublished paper, 1973 (b).

Gardner, H. The naming of objects and symbols by children and aphasic patients. Unpublished paper, 1973 (c).

Geschwind, N. The development of the brain and the evolution of language. Monograph Series of Languages and Linguistics, 1964, 17, 155-170.

Gombrich, E. H. Art and illusion. New York: Pantheon Books, 1960.

Goodman, N. Languages of art. Indianapolis, Ind.: Bobbs-Merrill, 1968.

Honkavaara, S. The psychology of expression. British Journal of Psychology Monograph Supplement, 1961, 23.

Inhelder, B. & Piaget, J. The growth of logical thinking from childhood to adolescence. New York: Basic Books, 1958.

Jakobson, R. Linguistics and poetics. In T. Sebeok (Ed.) Style in language. Cambridge, Mass.: MIT Press, 1960.

Jakobson, R. Unpublished lecture, Harvard University, 1970.

Kennedy, J. Images and information. San Francisco: Jossey-Bass, 1974, in press.

Kohlberg, L. Stage and sequence: The cognitive-developmental approach to socialization. In D. Goslin (Ed.) Handbook of socialization theory and research. New York: Rand McNally, 1969.

McNeill, D. The acquisition of language. New York: Harper and Row, 1970.

Nunmedal, J. G. & Murray, R. B. Semantic factors in conversation of weight. Psychonomic Science, 1969, 16, 323-324.

Rossi, S. & Wittrock, M. C. Developmental shifts in verbal recall between mental ages two and five. Child Development, 1971, 42, 333-338.

Schaffer, L. F. Children's interpretation of cartoons. Contributions to Education (Columbia Teacher's College), 1930, 429.

Snider, J. G. & Osgood, C. E. Semantic differential technique. Chicago. Aldine, 1969.

Stevenson, H. Children's learning. New York: Appleton-Century Crofts, 1972.

Werner, H. Comparative psychology of mental development. New York: Science Editions, 1961.

Werner, H. and Kaplan, B. Symbol formation. New York: Wiley, 1963.

FOOTNOTES

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[1] Accordingly each subject's score for the abstract line configuration domain was adjusted (through multiplication by .8) whenever performance on the various domains was compared in the study.